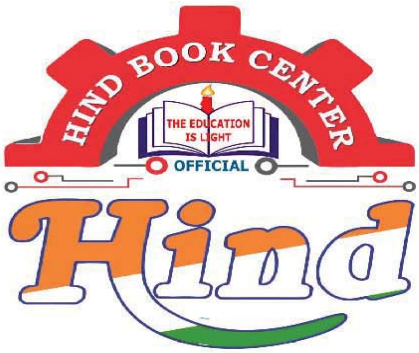

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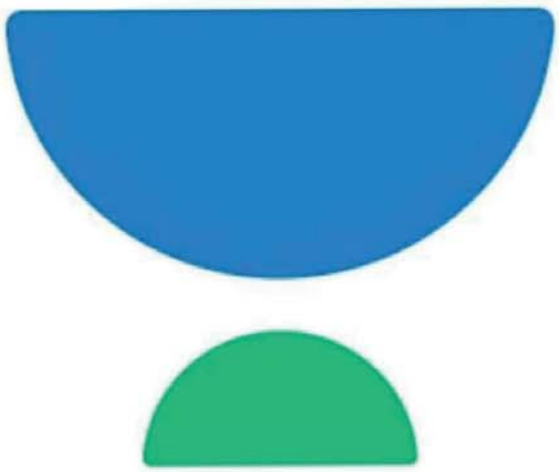

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Jaspal Sir's Structure Analysis

Handwritten Notes

Written
By
Roopali Rai

Lesson 1 Feb 16

Structural Analysis

- Structure can be defined as body of connected parts that is designed to carry loads even it is not intended to be occupied by us.

For eg : Bridges, dams, Railways, Retaining wall, tunnel, canals etc.

- The aim of structural analysis is to find force/moments in various components/parts of the structure.
- For the structure to remain in equilibrium, net forces (force & moments) acting on it must be zero in all directions.

Note :→ If net force acting on body is zero & that body is at rest then it is termed to be in static equilibrium.

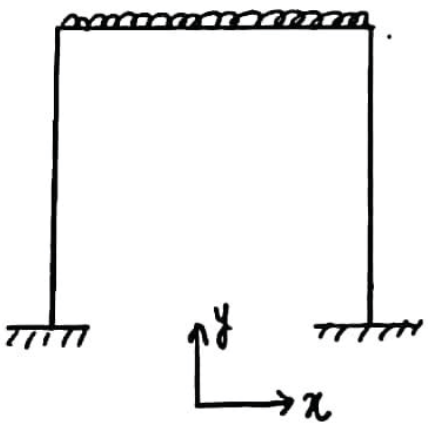
Foreg :→ Aircraft flying, train running, vessel sailing, car moving with const speed : Equilibrium.

But, Bridge, Dam, canal, retaining wall : static Equilibrium

- In a 2D structure or plannar structure (in which all the members & forces are in one plane only), the equations of equilibrium are

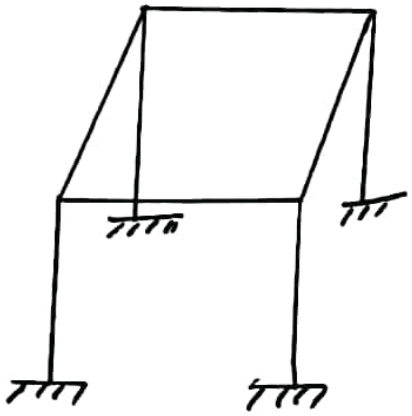
$$\left.\begin{aligned} \Sigma F_x &= 0 \\ \Sigma F_y &= 0 \\ \Sigma M_z &= 0 \end{aligned}\right\} \text{3no's}$$

The above structure is assumed to be in x-y plane.



- In 3D structure or space structure (In which members & forces are in ~~3D~~ not in single plane) or are in 3D), the equations of equilibrium are :-

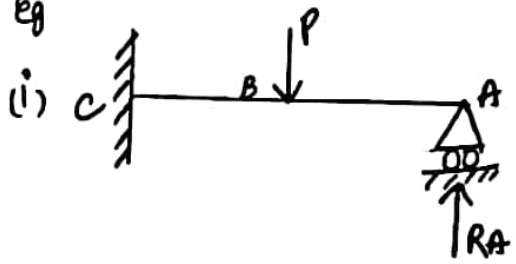
$$\left.\begin{aligned} \Sigma F_x &= 0 \\ \Sigma F_y &= 0 \\ \Sigma F_z &= 0 \\ \Sigma M_x &= 0 \\ \Sigma M_y &= 0 \\ \Sigma M_z &= 0 \end{aligned}\right\} \text{6 no.'s}$$



- In the analysis of structure can't be done just by using equations of equilibrium, then compatibility & energy equations are used.

Eg

(i)



$\delta_A = 0$

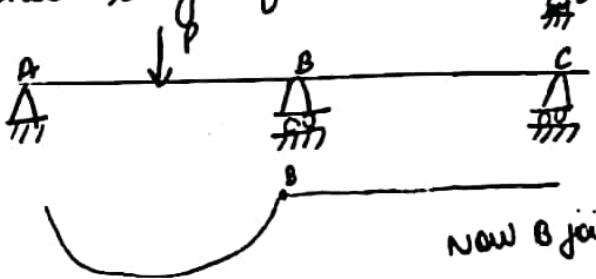
$\downarrow \delta_{load\ P} - \uparrow \delta_{R_A} = 0$

(ii)

$\Delta_{AB} = 0$

$\Delta_{Temp} - \Delta_R = 0$

- Here compatibility may be termed as continuity or good fit of material or structure or member or joint while being deformed under loading.



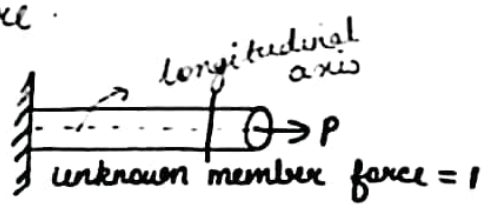
Compatibility eq^n not satisfy because support cannot be lifted.

Now B joint is not continous.

. It is not compatible due to lifting of joint C

Types of Members Forming structure.

A) Axial member

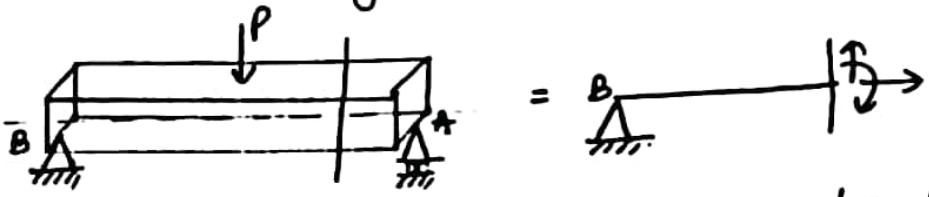


- It is the simplest structural member
- for eg. bar or rod
- An axial member is a long straight body on which the forces are being applied along the longitudinal axis.
- An axial member can support axial force. (both tensile or compressive)

B) Beam / Frame Member

- It is a line element / member (element whose one dimension (length) is comparatively more than other two dimension (width, depth)) which is designed to resist SF & BM due to transverse load / moment.

Note :→ Transverse load is that load which is applied normal (⊥r) to the longitudinal axis.



unknown member force = 3
(axial force, SF, BM).

C) Cable.

- It is made of rope, chain or wire that serves different functions (according to the application)
- A cable can support axial force only, nature of which is tensile.

unknown member force = 1
(axial tension)

Lesson 2 Feb 17.

Types of support

- It is the boundary arrangement that can restrain movement of any point of the structure
- Due to the restrainment of the movement, reactions are developed at the support in the direction opposite to the expected movement.
- Supports are generally of following types :→

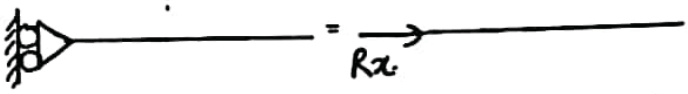
A) Roller / Simple / Rocker support.

- It is the simplest support that gives only one reaction because only one movement is restrained.

Reaction developed = 1 (Ry)

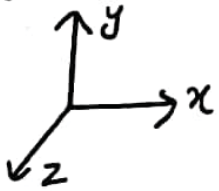
- Rollers can also have different orientations as :→

a)

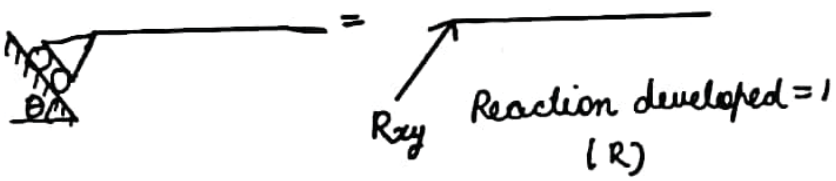


Movement restrained "x"

Reaction developed = 1 (Rx)

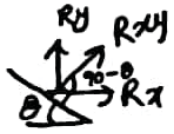


b)



Movement restrained "xy"

Reaction developed = 1 (R)

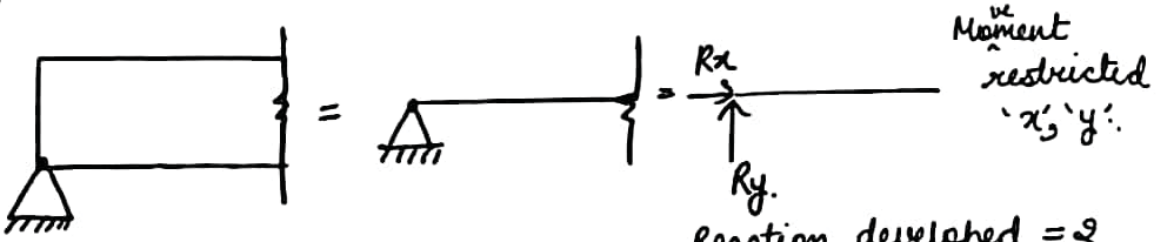


$Rx = Rxy \sin\theta$

$Ry = Rxy \cos\theta$

B) Hinged / Pinned support

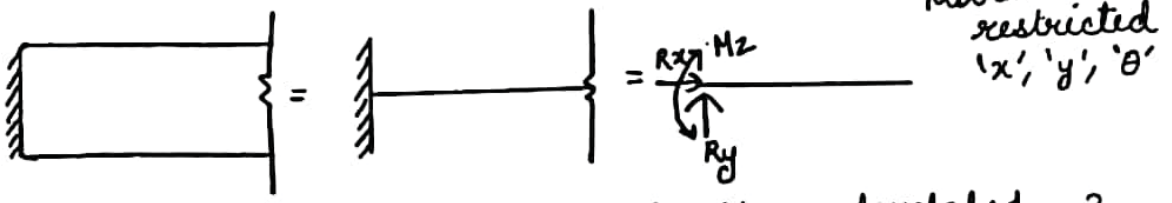
- A pin/hinge gives resistance against <u>two</u> movement, hence offers two reactions



Reaction developed = 2
(Rx, Ry.)

C) Fixed support

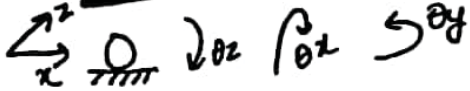
- It is the support that <u>restrains complete movement</u> of the point of structure.
- Hence, it offers three reactions



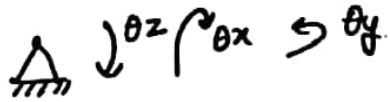
Reactions developed = 3.
(Rx, Ry, Mz)

Note:→ <u>Number of reactions</u> in 3D or space structure

① No. of reactions



1 (Ry)



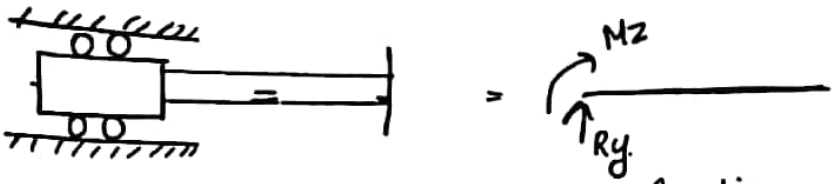
3 (Rx, Ry, Rz).

6 (Rx, Ry, Rz, Mx, My Mz)

② Inclined roller support & hinge support both restrict the movement in x & y direction but inclined roller support offers 1 reaction (as θ is known) & hinged support offers 2 reaction (as θ is unknown)

d) Guided Roller Support.

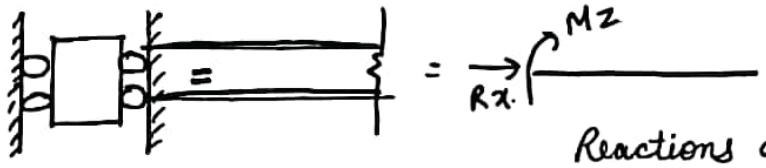
- It is the type of roller support, movement of which is guided / restrained in a particular direction, hence it offers 1 additional reaction



Movement restricted
(y, θ)

Reactions developed = 2.
(Ry, Mz)

or

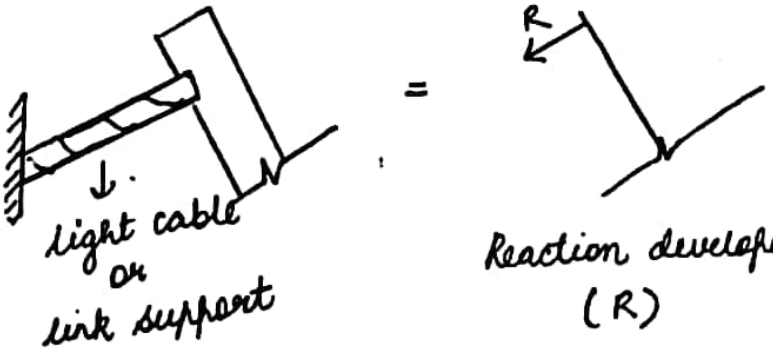


Movement restricted
(x, θ).

Reactions developed = 2
(Rx, Mz)

e) Link support

- It is the type of support in which reaction is developed in the direction of cable or link



Movement restricted
(axial pull)

Light cable
or
link support

Reaction developed = 1
(R)